

I Claim:

1. A variable rate volumetric particle counter comprising:

a sample pump having a control input, a sample input and a sample output, the sample pump sample output having a sample volumetric delivery rate responsive to the sample pump control input;

a sheath pump having a control input, a sheath fluid input and a sheath fluid output, the sheath pump sheath fluid output having a sheath volumetric delivery rate in a laminar flow stream responsive to the sheath pump control input;

a flow cell coupled to the sample pump sample output and the sheath pump sheath fluid output so that the sample is drawn in a suspension stream of a fixed diameter into the sheath fluid stream;

a detection assembly comprising at least one sensor having an output indicative of a characteristic of the drawn suspension;

a data analyzer for analyzing the detected characteristic with respect to predetermined criteria and determining control parameters to achieve the predetermined characteristic criteria;

a sample rate controller coupled to the data analyzer and having a control output connected to the control input of the sample pump for controlling the sample pump to vary the sample volumetric delivery rate in response to the control parameters; and

a sheath rate controller coupled to the data analyzer and having a control output connected to the sheath pump for controlling the sheath pump to vary the sheath volumetric delivery rate in response to the control parameters.



2. The apparatus of claim 1 wherein the sheath pump is a syringe pump.
3. The apparatus of claim 2 wherein the sample pump is driven by a sample pump motor controlled by the sample controller.
4. The apparatus of claim 1 wherein the sample pump is a syringe pump.
5. The apparatus of claim 4 wherein the sheath pump is driven by a sheath motor controlled by the sheath controller.
6. The apparatus of claim 1 wherein the sample is a cell reaction mixture.
7. The apparatus of claim 6 wherein the fixed diameter is substantially that of one cell in the cell reaction mixture.
8. The apparatus of claim 1 wherein the detection assembly comprises an optical detection system.
9. The apparatus of claim 1 wherein the detection assembly comprises a magnetic detection system.
10. The apparatus of claim 1 wherein the data analyzer, sample controller and sheath controller are disposed within a single device.
11. The apparatus of claim 1 wherein the data analyzer includes at least one preprogrammed pump profile for determining the control parameters.
12. A variable rate volumetric particle counter comprising:  
means for delivering a sample at a sample volumetric delivery rate;  
means for delivering a sheath fluid at a sheath volumetric delivery rate in a laminar flow stream;



means for drawing the sample in a suspension stream of a fixed diameter into the sheath fluid stream;

means for detecting a characteristic of the drawn suspension;

means for analyzing the detected characteristic with respect to predetermined  
5 criteria and determining control parameters to achieve the predetermined characteristic criteria;

means for controlling the sample pump to vary the sample volumetric delivery rate in response to the control parameters; and

means for controlling the sheath pump to vary the sheath volumetric delivery rate in response to the control parameters.

10 13. The apparatus of claim 12 wherein the sample is a cell reaction mixture.

14. The apparatus of claim 13 wherein the fixed diameter is substantially that of one cell in the cell reaction mixture.

15. The apparatus of claim 12 wherein the data analyzer comprises at least one preprogrammed pump profile for determining the control parameters.

15 16. The apparatus of claim 12 wherein the sheath pump is a syringe pump.

17. The apparatus of claim 12 wherein the sample pump is a syringe pump.

18. A method for determining a characteristic of a sample comprising the steps of:

delivering the sample at a sample volumetric delivery rate;

delivering a sheath fluid at a sheath volumetric delivery rate in a laminar flow stream;

drawing the sample in a suspension stream of a fixed diameter into the sheath stream;

detecting a characteristic of the drawn suspension;



analyzing the detected characteristic with respect to predetermined criteria and determining control parameters to achieve the predetermined characteristic criteria;

controlling the sample pump to vary the sample volumetric delivery rate in response to the control parameters; and

controlling the sheath pump to vary the sheath volumetric delivery rate in response to the control parameters.

19. The method of claim 18 wherein the sample is a cell or particle reaction mixture.

20. The method of claim 18 wherein the characteristic is a particle or cell count.

21. The method of claim 18 wherein the control parameters are derived from predetermined pump profiles.

22. The method of claim 18 wherein controlling the sample pump and controlling the sheath pump further comprising adjusting the volumetric delivery rate of at least one of the sample pump and the sheath pump to produce a detected characteristic in a predetermined range between a minimum value and a maximum value.